

*THE EVALUATION AND TREATMENT OF
AGGRESSION MAINTAINED BY ATTENTION AND
AUTOMATIC REINFORCEMENT*

RACHEL H. THOMPSON, WAYNE W. FISHER,
CATHLEEN C. PIAZZA, AND DAVID E. KUHN

KENNEDY KRIEGER INSTITUTE AND
JOHNS HOPKINS UNIVERSITY SCHOOL OF MEDICINE

In the current investigation, we used direct and indirect methods to assess and treat several topographies of aggression that were hypothesized to have separate operant functions in a young boy with severe mental retardation and pervasive developmental disorder. First, a functional analysis of aggression, using the methods described by Iwata, Dorsey, Slifer, Bauman, and Richman (1982/1994), was conducted and produced inconclusive results. Next, indirect methods were used to develop a second functional analysis, which showed that chin grinding (firmly pressing and grinding his chin against the skin and bones of others) persisted independent of social contingencies and that the other topographies of aggression (e.g., hitting, kicking) were maintained by social positive reinforcement (attention). A treatment designed to decrease aggression maintained by attention—functional communication training with extinction—reduced all forms of aggression except chin grinding. This latter topography of aggression, which we hypothesized was maintained by automatic reinforcement, was reduced when the response–reinforcer relation was interrupted through response blocking and the child was provided with an alternative form of chin stimulation.

DESCRIPTORS: aggression, autism, automatic reinforcement, developmental disabilities, functional analysis

The development of the functional analysis method (Iwata, Dorsey, Slifer, Bauman, & Richman, 1982/1994) has provided clinicians with an effective technology for empirically evaluating multiple functions of destructive behavior simultaneously. Epidemiological studies of self-injurious behavior (SIB; Iwata et al., 1994) and other problem behavior (Derby et al., 1992) have shown that the function of behavior can be identified in most cases. However, in a significant minority of cases, functional analysis results have been inconclusive.

Several explanations for undifferentiated

functional analysis results have been proposed. Derby et al. (1994) suggested that functional analyses may be inconclusive when different response categories (e.g., aggression, self-injury, stereotypies) have separate operant functions. Derby et al. examined the functional analyses of 4 individuals when (a) the data for all response categories were aggregated on a single graph and (b) the results for each response category (e.g., aggression, stereotypy) were graphed separately. For 2 participants, the rates of aberrant behavior for the aggregated data showed considerable overlap among the various functional analysis conditions, and thus no clear operant function was identified. By contrast, for these 2 participants, when the results for each response category were graphed individually, separate operant functions were identified for two different response categories (e.g., stereotypies maintained by automatic reinforcement, aggres-

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Requests for reprints should be sent to Wayne W. Fisher, Neurobehavioral Unit, The Kennedy Krieger Institute, 707 N. Broadway, Baltimore, Maryland 21205.

sion maintained by escape from nonpreferred tasks). Derby *et al.* suggested that when separate response categories are members of different operant classes, functional analysis results may be difficult to interpret if the data for these topographies are aggregated.

Functional analyses may also yield inconclusive results when one or more topographies of destructive behavior are maintained by automatic reinforcement (Vollmer, Marcus, & LeBlanc, 1994). When this is the case, the reinforcer responsible for behavioral maintenance is available in all conditions because it is inseparably tied to the target response (Piazza, Hanley, & Fisher, 1996). Thus, responding may be high across all functional analysis conditions (Iwata *et al.*, 1994) or may be higher when the automatic reinforcer is established by the experimental conditions (e.g., conditions with low levels of environmental stimulation such as alone; Iwata *et al.*, 1994) or pre-session conditions (e.g., sleep deprivation, access to stimulating activities; Kennedy & Meyer, 1996; O'Reilly, 1995).

Automatic reinforcement has been commonly hypothesized as a maintaining variable for stereotypic behavior or self-injurious behavior. For example, auditory (Rincover & Devany, 1982), oral (Favell, McGimsey, & Schell, 1982), tactile (Goh *et al.*, 1995), and visual (Kennedy & Souza, 1995) stimuli have been hypothesized to serve as automatic reinforcement for SIB. However, at least some of these forms of stimulation also may be produced by other aberrant behaviors such as aggression (e.g., slapping others) and property destruction (e.g., banging on walls, tearing paper). Thus, it is possible that automatic reinforcement may, in some cases, be responsible for the maintenance of these problem behaviors as well (Marcus, Vollmer, Ringdahl, & Roane, 1996). To date, however, we have identified no studies in which functional analyses indicated that aggression

was maintained independent of social consequences.

When destructive behavior is maintained by social consequences, treatment often involves discontinuing reinforcement for problem behavior (i.e., extinction) and providing that reinforcer for an alternative, appropriate behavior (e.g., communication, compliance). However, when automatic reinforcement is responsible for behavioral maintenance, treatment development may be difficult because the specific reinforcer that is responsible for behavior maintenance is often unknown or cannot be directly manipulated (Piazza, Hanley, & Fisher, 1996).

Several studies have attempted to identify specific sources of automatic reinforcement for SIB through indirect methods. Goh *et al.* (1995) conducted a study with 9 individuals who engaged in hand mouthing that was hypothesized to be maintained by automatic reinforcement in the form of either mouth or hand stimulation. Individuals were provided with toys, and data were collected on hand-to-toy contact, mouth-to-toy contact, and hand-to-mouth contact. Stimulation involving the hand (either hand to mouth or hand to toy) was observed most frequently for all 9 participants. Based on these data, the researchers suggested that hand mouthing was most likely maintained by access to hand stimulation for these individuals.

Similarly, Kennedy and Souza (1995) assessed and treated eye poking that was hypothesized to be maintained automatically by the visual stimulation produced by the response. Indirect evidence for their hypothesis was provided by (a) establishing that eye poking was maintained independent of social consequences, (b) decreasing eye poking by interrupting the response–reinforcer relation (application of goggles), and (c) demonstrating that visual stimulation (a video game) reduced eye poking more than auditory stimulation (listening to music) did. Fi-

nally, Piazza, Hanley, and Fisher (1996) assessed and treated cigarette pica that was hypothesized to be maintained by the effects of nicotine. They completed a series of analyses to support their hypothesis by (a) showing that pica was maintained in a condition with no social consequences when the available cigarettes contained nicotine but not when the cigarettes contained herbs without nicotine, (b) confirming that tobacco was preferred over the other components of the cigarette (e.g., paper, filter, etc.), (c) establishing that cigarette pica was maintained independent of social consequences, and (d) demonstrating that a treatment designed to interrupt the hypothesized response-reinforcer relation reduced consumption of cigarettes to zero.

The purpose of the current investigation was to evaluate several topographies of a child's aggression that appeared to be maintained by different types of reinforcement (i.e., both social and nonsocial). We used direct strategies (e.g., functional analysis, functional analysis-based treatments) to assess and treat the topography of aggression that was maintained by social reinforcement. We used indirect strategies (e.g., Goh et al., 1995; Kennedy & Souza, 1995; Piazza, Hanley, & Fisher, 1996) to assess and treat the topography of aggression (chin grinding) that appeared to be maintained by automatic reinforcement.

GENERAL METHOD

Subject and Setting

Ernie was a 7-year-old boy with severe mental retardation, pervasive developmental disorder, and severe hemophilia who had been admitted to an inpatient unit specializing in the assessment and treatment of severe behavior disorders. He was ambulatory and responded to simple one-step directions, but was nonverbal and needed assistance with most self-care tasks (e.g., dressing, toi-

leting). The primary target behavior was aggression, which included hitting, kicking, pinching, and scratching, and firmly pressing and grinding his chin against others. Chin grinding was the topography of aggression that Ernie reportedly displayed most frequently. This response topography was categorized as aggression rather than SIB because (a) chin grinding often resulted in severe bruising and pain to caregivers, (b) chin grinding did not result in tissue damage to Ernie's chin, and (c) he usually did not grind his chin against himself or inanimate objects. Sessions during all analyses were conducted by trained therapists in a room (3 m by 3 m) equipped with a one-way mirror. Treatment extension sessions were conducted on the living unit and in Ernie's classroom after discharge.

Response Definitions and Data Collection

During Phase 1 of Experiment 1, data were collected on the frequency of aggression (chin grinding, hitting, kicking, pinching, scratching). Based on observations made after the first functional analysis, it appeared that chin grinding and other topographies of aggression belonged to separate operant classes; therefore, data-collection procedures were modified for the remainder of the study. Data were collected on (a) chin grinding on the therapist (any chin-to-body contact), (b) other aggression (hitting, kicking, pinching, scratching), (c) appropriate communication (handing a picture communication card to the therapist), and (d) alternative chin grinding against a device that was designed to produce chin stimulation similar to that provided by chin grinding on people. Data collectors recorded the frequency of other aggression and appropriate communication and the occurrence of chin grinding and alternative chin grinding within 10-s intervals.

Interobserver Agreement

During all sessions, trained observers used laptop computers to record target responses from behind a one-way mirror. Sessions were 10 min in length and were partitioned into 60 10-s intervals to calculate interobserver agreement. Exact, occurrence, and nonoccurrence agreement coefficients were calculated by dividing the number of agreements by the number of agreements plus disagreements and multiplying by 100%. Exact agreement coefficients were calculated for behaviors that were scored with frequency measures: aggression, other aggression, and appropriate communication. An exact agreement was defined as both observers recording the same frequency of a target response in a given 10-s interval. Occurrence and nonoccurrence agreement coefficients were calculated for behaviors scored using a partial-interval recording method: chin grinding (on people) and alternative chin grinding (on the device). An occurrence agreement was defined as a 10-s interval in which both observers recorded the target response. A nonoccurrence agreement was defined as a 10-s interval in which both observers did not record the target response.

During Phase 1, two data collectors recorded the frequency of target responses for 44.2% of the sessions, and exact agreement coefficients averaged 97.7% for aggression and 99.2% for other aggression. For chin grinding, occurrence and nonoccurrence coefficients averaged 80.5% and 95.2%, respectively. Interobserver agreement was assessed during 76.9% of the sessions in Experiment 2, and exact agreement coefficients averaged 98.6% for aggression and 99.2% for appropriate communication. For chin grinding, occurrence and nonoccurrence agreement coefficients averaged 83.4% and 93.2%, respectively. In Experiment 3, interobserver agreement was assessed during 53.1% of the sessions, and occurrence and

nonoccurrence agreement coefficients averaged 80.4% and 96.1%, respectively, for chin grinding (on people) and 86.9% and 98.3% for alternative chin grinding (on the device), respectively.

EXPERIMENT 1: FUNCTIONAL ANALYSES

PHASE 1

First Functional Analysis

Procedure. An analogue functional analysis was conducted using procedures similar to those described by Iwata *et al.* (1982/1994) and included demand, social attention, tangible, and play conditions with the following modifications. An alone condition was not conducted with Ernie because the primary topography of concern was aggression. An ignore condition was not conducted because, as is customarily the case, aggression was initially hypothesized to be socially motivated. The demand condition was modified slightly because Ernie's caregivers reported that they seldom asked him to complete tasks independently and that completing self-care tasks with him was a problem. Therefore, during the demand condition, the therapist performed self-care tasks (e.g., toothbrushing, face washing). Each task was performed for 30 s. If Ernie did not engage in aggression during the 30-s interval, the therapist delivered praise for his cooperation at the end of the interval. If Ernie engaged in aggression, the task was terminated for 30 s (escape).

Results. The results of the first functional analysis are presented in the top panel of Figure 1. Rates of aggression were similar across functional analysis conditions, with more variability in the play and social attention conditions. Ernie displayed the highest rates of aggression in the play condition ($M = 1.13$ responses per minute; range, 0 to 5.1), followed by social attention ($M = 0.9$; range, 0 to 4.8), tangible ($M = 0.4$; range,

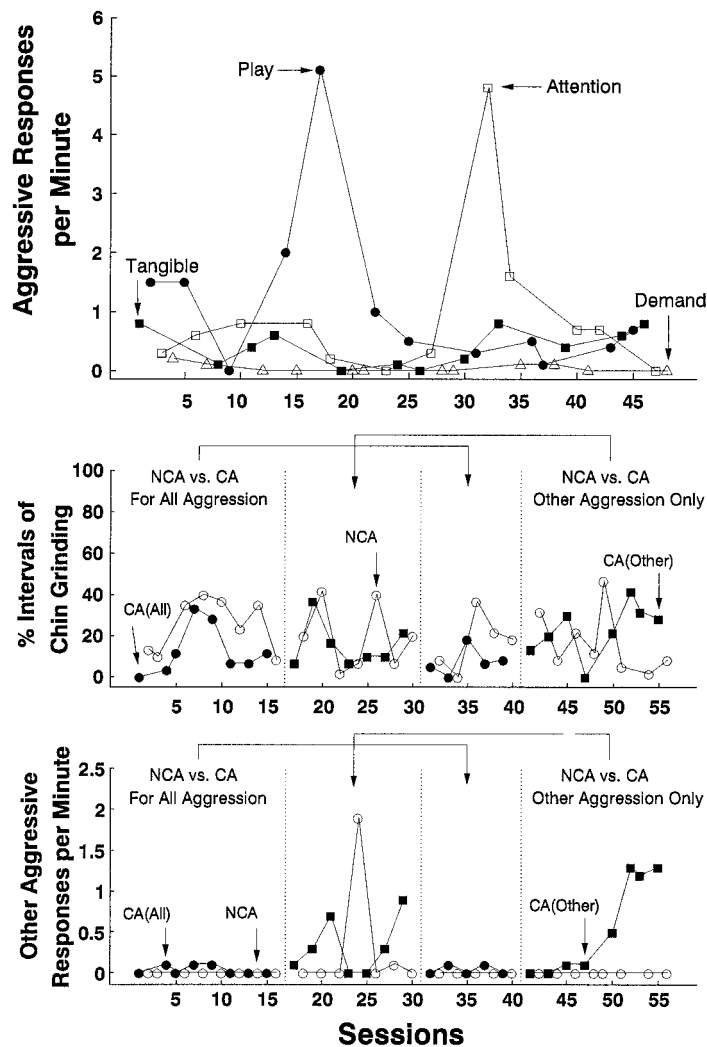


Figure 1. The rates of aggression during the four analogue conditions of the initial functional analysis (attention, demand, tangible, and toy play) are depicted in the top panel. The remaining panels show the percentages of intervals of chin grinding (middle panel) and rates of other aggression (bottom panel) during the second functional analysis when attention was provided (a) noncontingently (NCA), (b) contingent on all aggression (CA [all]), or (c) contingent only on other aggression (CA [other]).

0 to 0.8), and demand ($M = 0.04$; range, 0 to 0.2). No maintaining variables could be clearly identified for aggression based on the results of this functional analysis. The results suggested that negative reinforcement was not a maintaining consequence, because near-zero rates of aggression occurred in the demand condition. However, we could neither rule in nor rule out positive reinforcement in the form of attention as a main-

taining consequence, because the rates of aggression were elevated in both the attention and toy play conditions.

When the results of a functional analysis are inconclusive, we often use descriptive data to generate additional hypotheses regarding the function of aberrant behavior. We begin with informal, anecdotal observations (e.g., during the functional analysis, parent-child interactions) and proceed to

more structured descriptive assessments (e.g., A-B-C data; Sulzer-Azaroff & Mayer, 1977) as needed. In the current case, our hypotheses were generated based solely on informal observations of therapist-child interactions during the functional analysis, and parent-child and staff-child interactions on the living unit. We observed that chin grinding occurred most often when no structured activities were available. Ernie's other aggression (e.g., hitting, kicking, scratching) occurred most often in low-attention situations when Ernie attempted to engage in physical interaction with staff (e.g., attempting to climb on the laps of staff members) but was not allowed to do so. However, when Ernie was engaged in a structured activity (e.g., schoolwork), all topographies of aggression occurred infrequently.

Based on these observations, we hypothesized that Ernie's chin grinding and other aggression were members of two different operant classes. Specifically, we hypothesized that chin grinding was maintained by automatic reinforcement and would persist in the absence of social consequences and that other aggression served to gain access to adult attention, which included physical contact (e.g., hugs, sitting in an adult's lap). We tested these hypotheses in subsequent analyses.

We also observed that chin grinding often occurred for extended periods of time (e.g., up to about 2 min) whereas the other topographies of aggression were discrete responses that lasted no more than a second or two. Whenever possible, we measure the strength of a response by its rate (see Skinner, 1938, for a discussion). Because other aggression consisted of brief, discrete responses but chin grinding occurred for more extended periods of time, we believed it was reasonable to use a rate measure for the former response but not for the latter. Therefore, we measured the strength of chin grinding using an interval recording system (Bijou, Peterson, & Ault, 1968).

PHASE 2

Second Functional Analysis

Procedure. A second functional analysis was conducted to assess the effects of social attention on Ernie's chin grinding and other aggression. Conditions in which attention was delivered contingent on all aggression (CA [all]) or only on other aggression (CA [other]) were compared with a noncontingent attention (NCA) control condition in a multielement design.

In the first phase of the analysis, the test condition, CA (all), consisted of 30 s of verbal and physical attention (e.g., the therapist talked to Ernie and allowed him to climb on the therapist's lap) contingent upon both chin grinding and other aggression on a fixed-ratio (FR) 1 schedule. In the control condition (NCA), Ernie received continuous physical and verbal attention throughout the session, and chin grinding and other aggressive responses were ignored.

In the next phase of the analysis, the test condition, CA (other), was modified so that only other aggression produced 30 s of verbal and physical attention on an FR 1 schedule, and chin grinding was ignored. The control condition (NCA) was identical to the control condition in the first phase of the analysis. The first and second phases of this analysis were then replicated using an ABAB design.

Results. The results of the second functional analysis are presented in the middle and bottom panels of Figure 1. During the second functional analysis, Ernie displayed relatively high levels of chin grinding in all conditions. He displayed chin grinding in a mean of 19.9% of intervals (range, 0% to 46.7%) during NCA, 10.8% (range, 0% to 33.3%) during CA (all), and 19.7% (range, 0% to 41.7%) during CA (other).

Near-zero rates of other aggression were observed in the control condition ($M = 0.07$ responses per minute; range, 0 to 1.9)

throughout the analysis, with the exception of one point (Session 24) in which Ernie displayed high rates of other aggression for unknown reasons. In the first phase of the analysis, CA (all), near-zero rates of other aggression ($M = 0.04$ responses per minute; range, 0 to 0.1) were observed when attention was available for both chin grinding and other aggression. We hypothesized that Ernie displayed low rates of other aggression in this condition because attention was available for chin grinding; therefore, other aggression was unnecessary to produce attention. In the next phase, chin grinding was ignored and other aggression continued to result in attention. During CA (other), when other aggression produced attention and chin grinding was ignored, other aggression increased ($M = 0.33$ responses per minute; range, 0 to 0.9). When both chin grinding and other aggression produced attention, in the second CA (all) phase, other aggression decreased to near zero ($M = 0.04$ responses per minute; range, 0 to 0.1). We then replicated the CA (other) phase in which only other aggression produced attention, and other aggression increased to a mean of 0.6 responses per minute (range, 0 to 1.4).

In summary, chin grinding persisted independent of whether attention was provided continuously and noncontingently (during NCA) or episodically and contingently (during either CA condition). By contrast, other aggressive responding occurred almost exclusively when it was the only means of gaining attention (during CA [other]). The results of this analysis suggested that Ernie's other aggression was maintained by access to adult attention and that his chin grinding was not sensitive to adult attention as a reinforcer. Furthermore, although providing attention for chin grinding had little or no effect on levels of chin grinding, it resulted in a decrease in other aggression. This presumably occurred because when attention was available for chin grinding, it reduced

Ernie's motivation to produce attention through other aggression.

EXPERIMENT 2: TREATMENT OF ATTENTION-MAINTAINED AGGRESSION

Procedure

Functional communication training (FCT) was used to reduce Ernie's attention-maintained aggression. In baseline, Ernie's other aggression resulted in 30 s of contingent verbal and physical attention (e.g., the therapist talked to Ernie and he was allowed to sit in the therapist's lap) on an FR 1 schedule. Chin grinding was ignored, and the picture communication card was not available.

Next, Ernie was trained to hand a picture communication card (a picture of Ernie hugging the therapist) to the therapist to gain 30 s of verbal and physical attention (e.g., hugs, praise). Each training session consisted of 10 trials. The communication card was placed in front of Ernie at the beginning of each trial. If Ernie handed the card to the therapist, he received 30 s of verbal and physical attention. If Ernie did not hand the card to the therapist independently within 15 s, he was prompted to do so using verbal and gestural prompts. Training was completed when Ernie gave the card to the therapist independently on 80% of the trials for three consecutive sessions. All aggressive responses were ignored during training trials.

When training was completed, FCT plus extinction was implemented. Ernie received 30 s of verbal and physical attention (e.g., hugs, praise) for handing the picture communication card to the therapist. Chin grinding and other aggressions were ignored. An ABAB design was used to compare FCT plus extinction to baseline.

Results

Figure 2 shows the effects of FCT plus extinction on other aggression and chin grinding. This intervention decreased other aggression from a baseline mean of 1.0 response per minute (range, 0 to 1.7) to a treatment mean of 0.07 responses per minute (range, 0 to 0.5). In addition, Ernie displayed appropriate communication at a mean of 0.97 responses per minute (range, 0.1 to 1.4) during FCT plus extinction. Thus, the amount of reinforcement Ernie received for communication during treatment equaled the amount he received for other aggression during baseline. As expected, Ernie's chin grinding persisted in both the baseline and FCT plus extinction conditions even though it produced no programmed consequence. Ernie displayed chin grinding in a mean of 22.6% of the intervals (range, 0% to 60%) in baseline and 31.8% (range, 0% to 55%) of the intervals during FCT plus extinction.

EXPERIMENT 3: TREATMENT OF AUTOMATICALLY MAINTAINED AGGRESSION

PHASE 1

Evaluation of Treatment Package

Procedure. This phase was designed to evaluate a treatment that was developed to reduce Ernie's chin grinding. In the second functional analysis, we determined that Ernie's chin grinding persisted in the absence of social consequences. We hypothesized that this behavior was maintained by the reinforcement that resulted from chin grinding (tactile stimulation to the chin). Treatment consisted of providing Ernie with a similar type of stimulation for a response that would not result in injury to Ernie or to others. Because Ernie typically ground his chin against the forearms and chins of oth-

ers, we developed a device that would provide a similar type of surface for Ernie to press his chin against. The alternative chin-grinding device was made of a piece of rigid plastic tubing approximately 30 cm long with a diameter of 4 cm (designed to simulate the hardness of bone). A hard rubber ball (4 cm in diameter) was cut in half and fastened to the center of the tube (designed to be a protrusion similar to a chin). The entire structure was first covered with Slo-Foam padding (designed to simulate soft tissue) and then OpSite, a transparent adhesive film made by Smith & Nephew (designed to simulate skin). Medical staff indicated that Ernie would not sustain any injury from alternative chin grinding on the device.

The treatment consisted of multiple components designed (a) to provide Ernie with alternative tactile stimulation to his chin (the device), (b) to increase the probability that he would obtain this alternative reinforcement (prompting), and (c) to limit the extent to which he obtained tactile reinforcement by chin grinding on others (response blocking). Once every 30 s, the therapist held the device in front of Ernie's face (approximately 6 in.) and allowed him to press his chin against it. If Ernie did not press against the device within 5 s, the device was returned to the floor where Ernie had free access to it. If Ernie displayed alternative chin grinding against the device, the therapist continued to hold the device until Ernie stopped or held the device himself. In order to eliminate or lessen any sensory reinforcement that Ernie received for chin grinding on people, the therapist physically prevented Ernie from making contact between his chin and any part of the therapist's body. This was typically accomplished by the therapist placing his or her hands on Ernie's shoulders and gently moving his torso away from the area on which he was attempting to press. This treatment condition (blocking and device) was compared to a baseline condition

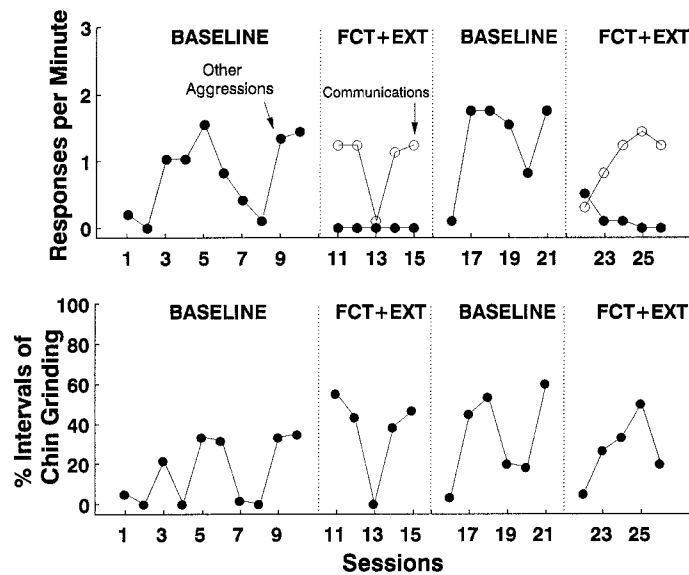


Figure 2. The effects of baseline and FCT plus extinction on the rates of other aggression and the percentages of intervals of chin grinding are presented in the top and bottom panels, respectively.

(ignore) in which the device was not present and chin grinding was ignored (i.e., not blocked). Continuous physical and verbal interactions (e.g., the therapist allowed Ernie to sit in his or her lap and engage in interactive toy play) were provided in both conditions. A multielement design was used to evaluate the treatment.

Results. The top panel of Figure 3 shows the effects of the treatment package (blocking and device) on chin grinding. The treatment package reduced chin grinding and attempts to a mean of 6.5% of the intervals (range, 1.7% to 13.3%) in comparison with the ignore condition ($M = 34.4\%$ of the intervals; range, 1.7% to 71.7%). In addition, the level of alternative chin grinding during treatment ($M = 30.6\%$ of the intervals) approximated that observed for chin grinding in the ignore condition.

PHASE 2

Analysis of Alternative Reinforcement

Next, we attempted to determine whether provision of alternative chin stimulation (i.e., the device) was an active treatment

component. The effects of the alternative chin device were evaluated by comparing a condition involving blocking with one involving blocking with the addition of the device. These two conditions were compared in a multielement design.

Procedure. As in the previous analysis, continuous verbal and physical interactions were available to Ernie in both conditions. In the blocking condition, Ernie was physically prevented from pressing his chin on the therapist. The blocking and device condition was identical to the blocking condition; however, the alternative chin-grinding device was present in the room throughout the session. Ernie was allowed to press his chin on the device at any time. In addition, as described above, the chin-grinding device was presented to Ernie once every 30 s.

Results. Ernie's percentage of chin grinding was substantially lower in the blocking and device condition compared with blocking alone. Ernie attempted to grind his chin on the therapist in a mean of 22.2% of the intervals (range, 10% to 36.7%) in the blocking condition and in a mean of 5.3%

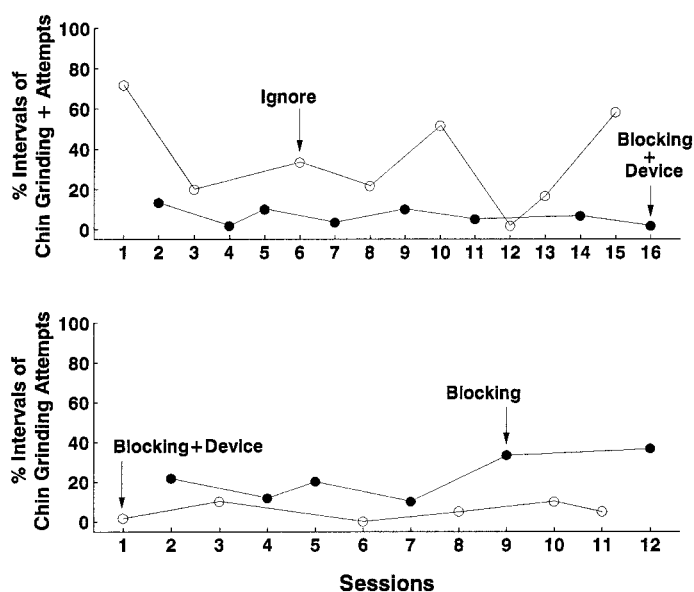


Figure 3. The top panel shows the percentages of intervals with chin grinding and chin-grinding attempts (conditions with blocking only) when there was no programmed consequence for the response (ignore) and when it was blocked and the alternative chin-grinding device was available (blocking plus device). The bottom panel shows the percentages of intervals with chin-grinding attempts when the response was blocked and the alternative chin-grinding device was either present (blocking plus device) or absent (blocking).

of the intervals (range, 0% to 10%) in the blocking and device condition. Ernie displayed alternative chin grinding ($M = 18.6\%$, range, 5% to 36.7%) at levels similar to that observed for chin grinding on the therapist when the device was not present.

Treatment Extension

The components used to treat each topography of aggression (chin grinding and other aggression) were combined into a package in which appropriate communication resulted in 30 s of attention, other aggressive responses were ignored, chin grinding was blocked, the alternative chin-grinding device was present, and Ernie had continuous access to toys identified through a stimulus preference assessment (Piazza, Fisher, Hanley, Hilker, & Derby, 1996). Initially, the treatment package was implemented in a session room. Next, a series of 12 sessions was conducted on the living unit with direct-care staff members as therapists. Ernie displayed toy play during 98% of the inter-

vals (range, 93% to 99.7%) and near-zero levels of chin grinding ($M = 0.42\%$, range, 0% to 5%), other aggression ($M = 0$), and alternative chin grinding ($M = 0$). In addition, follow-up data were collected in Ernie's classroom over a 6-month period. During this time, 20 observations ranging in length from 30 to 135 min were conducted, and data were collected on the frequency of Ernie's chin grinding and other aggressive behavior. Ernie attempted to grind his chin at a mean rate of 0.01 (range, 0 to 0.07) per minute and did not engage in other aggressive behavior during these observations.

GENERAL DISCUSSION

These results add to the literature on the functional analysis and treatment of aggression in five ways. First, the results demonstrate that aggression, like SIB and stereotypies, may sometimes persist in the absence of social consequences. An ignore condition was not included in the initial functional

analysis because we originally assumed that Ernie's aggression was maintained by social consequences. However, the results of the second functional analysis indicated that Ernie's chin grinding was maintained independent of social consequences. These results suggest that it may be important to assess whether aggression (and other responses that are typically maintained by social reinforcement) persists in the absence of social consequences.

Second, the results further illustrate how indirect functional assessments may be used to help to evaluate whether a response is maintained by automatic reinforcement and to help to specify the reinforcer (e.g., tactile stimulation to the chin). In a previous study, Kennedy and Souza (1995) hypothesized that a client's eye poking was maintained by the visual stimulation it produced. Providing the client with an alternative form of visual stimulation (video game) effectively reduced eye poking. Similarly, in the current investigation, providing Ernie with an alternative form of chin stimulation (grinding the chin against the alternative chin-grinding device) helped to reduce chin grinding to clinically acceptable levels. The fact that provision of the alternative form of chin stimulation was shown to be a necessary treatment component in Experiment 3 supports the hypothesis that chin grinding was maintained by the chin stimulation it produced (i.e., automatic reinforcement). In addition, in Experiment 3, Ernie's percentage of chin grinding on the device in the treatment condition was approximately equal to his percentage of chin grinding on the therapist in the baseline condition. These data suggest that the device provided a surface with qualities that allowed Ernie to experience a form of tactile stimulation similar to that produced through chin grinding on others.

Third, the results provide further support for categorizing responses along functional rather than topographical dimensions. Derby

et al. (1994) found that different response categories (e.g., stereotypy, SIB) sometimes belonged to separate operant classes and that aggregating data across categories may obscure their distinct behavioral functions. The current results extend those reported by Derby et al. by showing that different topographies within a single response category (i.e., different forms of aggression) may be members of separate operant classes. In general, all topographies of aggression are grouped together into a single response category during functional analyses (as was done in Phase 1 of Experiment 1). The current results show that a microanalysis of specific responses within generic categories is sometimes needed to separate functional response classes from topographical response categories.

Fourth, these results show how, during a functional analysis, a contingency for one response may not affect that behavior but may alter the probability of another response. The delivery of attention contingent on chin grinding had no effect on this response, presumably because chin grinding was maintained by the chin stimulation it automatically produced. However, delivery of attention for chin grinding reduced the probability of other aggression to near-zero levels, even though the contingency for this latter response remained constant (i.e., other aggression also produced attention). We hypothesized that Ernie received a sufficient amount of attention from chin grinding such that motivation to engage in other aggression was reduced. That is, the delivery of attention following chin grinding probably acted as an abolishing operation and reduced the effectiveness of attention as reinforcement for other aggression (Michael, 1993).

Fifth, the results provide further evidence regarding the benefits of developing treatments based on the results of functional analyses, even when the target behavior has

multiple functions (Lalli & Casey, 1996; Smith, Iwata, Vollmer, & Zarcone, 1993). The results of the second functional analysis suggested that different treatment approaches were needed for the two distinct operant classes (chin grinding and other aggression), and the results of the treatment analyses validated this hypothesis. The functional analyses conducted in this investigation led to effective treatments for all aggressive responses without reliance on intrusive default interventions.

One limitation of this study is that it involved only 1 participant, and thus the generality of the results remains unknown. A second potential limitation is that the procedures were more time consuming and complex than other functional analysis methods that have been used to assess multiple functions of aberrant behavior. For example, when the first functional analysis produced inconclusive results, it might have been more efficient to conduct another identical analysis while collecting data on chin grinding separate from other topographies of aggression, and then graphing the data using the procedures described by Derby *et al.* (1994). However, given that providing attention for chin grinding reduced Ernie's motivation to display other topographies of aggression, it is doubtful that the function of other aggression would have been detected using the procedures described by Derby *et al.*

A third potential limitation is that the treatment for chin grinding was unique and not very normalized. Ernie would certainly stand out in a crowd when he pressed his chin against the alternative chin-grinding device. A more socially acceptable treatment for automatically maintained aberrant behavior would have been to provide an alternative form of stimulation such as toy play (Vollmer *et al.*, 1994). Therefore, during treatment extension, a number of preferred toys were identified, and Ernie was given ac-

cess to these toys throughout most of the day. With the entire treatment in place, Ernie displayed high levels of toy play and rarely displayed alternative chin grinding, chin grinding, or other forms of aggression.

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STUDY QUESTIONS

1. Name two conditions that may increase the likelihood that a functional analysis will produce inconclusive results.
2. According to the authors, why is it often more difficult to assess and treat aberrant behavior hypothesized to be maintained by automatic (rather than social) reinforcement?
3. Why did the authors categorize chin grinding as aggression rather than self-injurious behavior?
4. Briefly describe the information obtained through informal observations that led to the hypothesis that chin grinding and other aggression belonged to separate operant classes.
5. Why did the authors use two different recording methods to measure chin grinding (i.e., interval recording) and other aggression (i.e., rate)?
6. According to the authors, why did the delivery of attention contingent on other aggression maintain this response in some conditions but not in others?
7. According to the authors, what was the automatic consequence of chin grinding that functioned as its reinforcement? Which findings support the authors' conclusions regarding the function of chin grinding?
8. The methods used in the current investigation to assess separate operant functions of dif-

ferent response topographies were more complex than the procedures developed by Derby et al. (1994). According to the authors, why were these more complex methods necessary in the current investigation?

9. What aspects of the investigation limit its external validity (i.e., the extent to which the results can be generalized to other subjects and settings)?

Questions prepared by Wayne W. Fisher and Rachel H. Thompson